

Claims

- [c1] 1. A system for generating high pressure hydrogen comprising:
- a storage tank;
 - a low pressure high volume hydrogen generator fluidly coupled to said storage tank; and,
 - a high pressure low volume hydrogen generator fluidly coupled to said storage tank.
- [c2] 2. The system for generating high pressure hydrogen of claim 1 wherein said low pressure hydrogen generator generates hydrogen gas between 20 psi and 400 psi.
- [c3] 3. The system for generating high pressure hydrogen of claim 2 wherein said low pressure hydrogen generator generates hydrogen gas at 200 psi.
- [c4] 4. The system for generating high pressure hydrogen of claim 1 wherein said high pressure hydrogen generator generates hydrogen gas between 1000 psi and 10,000 psi.
- [c5] 5. The system for generating high pressure hydrogen of claim 4 wherein said high pressure hydrogen generator generates hydrogen gas at 2400 psi.

- [c6] 6. The system for generating high pressure hydrogen of claim 1 where said low pressure hydrogen generator is an electrochemical cell.
- [c7] 7. The system for generating high pressure hydrogen of claim 6 where said high pressure hydrogen generator is an electrochemical cell.
- [c8] 8. The system for generating high pressure hydrogen of claim 1 where said low pressure hydrogen generator is a hydrocarbon reformer.
- [c9] 9. The system for generating high pressure hydrogen of claim 1 wherein said low pressure hydrogen generator generates hydrogen gas at a rate between 10 scfh and 80 scfh.
- [c10] 10. The system for generating high pressure hydrogen of claim 9 wherein said high pressure hydrogen generator generates hydrogen gas at a rate between 100 standard cubic centimeters per minute and 40 scfh.
- [c11] 11. A method for generating and storing high pressure hydrogen comprising:
generating hydrogen at a first pressure with a first hydrogen generator;
storing hydrogen at said first pressure in a storage

tank;
generating hydrogen with a second hydrogen generator at a second pressure higher than said first pressure until said storage tank reaches said second pressure.

- [c12] 12. A method for generating and storing high pressure hydrogen of claim 11 wherein said first pressure is between 20 psi and 400 psi.
- [c13] 13. A method for generating and storing high pressure hydrogen of claim 12 wherein said first pressure is 200 psi.
- [c14] 14. A method for generating and storing high pressure hydrogen of claim 12 wherein said second pressure is between 1000 psi and 10,000 psi.
- [c15] 15. A method for generating and storing high pressure hydrogen of claim 11 further comprising the steps of draining a hydrogen-water phase separator prior to the purging of a hydrogen gas dryer.
- [c16] 16. A regenerative fuel cell system comprising:
at least one hydrogen storage container;
a first hydrogen generator fluidly coupled to said storage container;
a second electrochemical hydrogen generator fluidly

coupled to said storage container, said second hydrogen generator generating hydrogen at a higher pressure than said first hydrogen generator; and, at least one power generator fluidly coupled to said storage container.

[c17] 17. The regenerative fuel cell system of claim 16 further comprising:

a water storage unit fluidly coupled to said first and second hydrogen generator.

[c18] 18. The regenerative fuel cell system of claim 16 wherein said first and second hydrogen generators include means for recovering water and returning the recovered water to said water storage unit.

[c19] 19. The regenerative fuel cell system of claim 18 further comprising:

a user interface electrically connected to said first and second hydrogen generator, said power generator, and said hydrogen storage container.

[c20] 20. The regenerative fuel cell system of claim 19 wherein said user interface includes means for disabling the first and second hydrogen generators, said power generator and said hydrogen storage container.

[c21] 21. The regenerative fuel cell system of claim 20 wherein

said at least one power generator includes a fuel cell.

[c22] 22. The regenerative fuel cell system of claim 21 wherein said first hydrogen generator includes an electrochemical cell.

[c23] 23. The regenerative fuel cell system of claim 21 wherein said first hydrogen generator includes a hydrocarbon reformer.

[c24] 24. The regenerative fuel cell system of claim 21 wherein said second hydrogen generator includes an electrochemical cell.

[c25] 25. A regenerative fuel cell system comprising:
at least one hydrogen storage container;
at least one hydrogen generator fluidly coupled to said storage container; and,
at least one power generator, each power generator including a fuel cell fluidly coupled to said storage container, an electric storage device, an unregulated dc bus electrically connected to said fuel cell and said electric storage device, and a DC/DC converter electrically connected to said unregulated dc bus.

[c26] 26. The regenerative fuel cell system of claim 25 further comprising a common dc buss electrically connected to said at least one hydrogen generator and each of said

fuel cell module unregulated dc buss.

- [c27] 27. The regenerative fuel cell system of claim 26 further comprising a water storage unit fluidly coupled to said at least one hydrogen generator.
- [c28] 28. The regenerative fuel cell system of claim 27 further comprising at least one second hydrogen generator coupled to said storage container and said water storage unit.
- [c29] 29. The regenerative fuel cell system of claim 28 further comprising a user interface electrically connected to said power generator, said storage container and said first and second hydrogen generators.
- [c30] 30. The regenerative fuel cell system of claim 29 wherein said user interface includes means for providing electrical power to said first and second hydrogen generator and said at least one power generator.
- [c31] 31. The regenerative fuel cell system of claim 25 wherein said unregulated dc bus is electrically connected to said at least one first hydrogen generator.
- [c32] 32. The regenerative fuel cell system of claim 28 wherein said unregulated dc bus is electrically connected to said at least one first hydrogen generator and said at least

one second hydrogen generator.

[c33] 33. The regenerative fuel cell system of claim 32 where in said unregulated dc bus is electrically connected to said storage container and said user interface.

[c34] 34. A health monitoring system for a regenerative fuel cell system comprising:
at least one hydrogen storage container having a first sensor associated therewith;
at least one hydrogen generator fluidly coupled with said storage container and having a second sensor associated therewith;
at least one power generator having a third sensor associated therewith; and,
a disconnect device electrically connected to said first, second and third sensors wherein said disconnect device disables said hydrogen generator, said power generator and said storage container in response to a signal from said first second or third sensor.

[c35] 35. The health monitoring system of claim 34 wherein said first, second or third sensor is chosen from a group comprising: thermal fuse, pyrometer, combustible gas detector, tachmeter, a smoke detector, a pressure switch, a pressure transducer, a flow switch or a level

sensor.

- [c36] 36. The health monitoring system of claim 34 wherein said disconnect device is a contactor.
- [c37] 37. A manifold for limited hydrogen flow to a power generator having a fuel cell, said manifold comprising:
an input port;
at least one output port fluidly coupled to said input port; and,
at least one orifice associated with said at least one output port, said orifice sized to limit hydrogen flow to the fuel cell to a predetermined maximum flow rate.
- [c38] 38. The manifold of claim 37 wherein said orifice has a diameter of 0.187 inches and limits the flow of gas to 99 liters per minute at 150 psi.